U.S. EPA Environmental Technology Verification Program
Advanced Monitoring Systems Center

Water Stakeholder Committee Meeting

January 29, 2004
San Antonio, Texas

<u>Meeting Minutes</u>

ATTENDEES

Stakeholder Committee Members:

John Carlton, Alabama Department of Environmental Management, Mobile, AL
Mick DeGraeve, Great Lakes Environmental Center, Traverse City, MI
Christine Kolbe, Texas Commission on Environmental Quality, Austin, TX
Marty Link, Nebraska Department of Environmental Quality, Lincoln, NE
Vito Minei, Suffolk County Department of Health Services/ Peconic National Estuary Program, Hauppauge, NY
Richard Sakaji, California State Department of Health Services, Berkeley, CA
Jeff Schloss, University of New Hampshire, Durham, NH
Geoff Scott, NOAA Center for Coastal Environmental Health and Biomolecular Research, Charleston, SC
Peter Tennant, Ohio River Valley Water Sanitation Commission, Cincinnati, OH
Kenneth Wood, DuPont Company, Wilmington, DE

Observers:

Linard Arocha, San Antonio River Authority, San Antonio, TX
Stephen Lusk, San Antonio River Authority, San Antonio, TX
Aaron Barkoh, Texas Parks and Wildlife Department, Ingram, TX

EPA/Battelle AMS Center Staff

Amy Dindal, Battelle, West Palm Beach, FL
Teresa Harten, U.S. EPA, Cincinnati, OH
Todd Peterson, Battelle, Seattle, WA
Karen Riggs, Battelle, Columbus, OH

Guest Speakers:

Al Cherepon, Texas Commission on Environmental Quality, Austin, TX
Joanna Mott, Texas A & M University, Corpus Christi, TX
Greg Southard, Texas Parks and Wildlife Department, San Marcos, TX

January 29, 2004

OPENING SESSION: WELCOME, AGENDA AND MEETING OBJECTIVES

Teresa Harten, U.S. EPA ETV Program Director, opened the meeting by expressing her appreciation for the contributions stakeholders are making to the ETV program. Karen Riggs, Battelle's ETV program manager welcomed participants.

Todd Peterson, facilitator of the ETV AMS Center's Water Stakeholder Committee reviewed the agenda and the meeting's objectives:

- Update the committee on the status of water quality monitoring technologies undergoing verification
- Inform the committee about water quality monitoring activities and challenges in Texas and the Gulf Coast
- Identify next technologies to consider for verification.

STAKEHOLDER INTRODUCTIONS

Mr. Peterson invited stakeholders and observers to introduce themselves, identify water quality monitoring challenges and describe briefly recent water quality monitoring activities. Mick DeGraeve of the Great Lakes Environmental Center noted the importance of rapid detection of *enterococci* in salt water. Christine Kolbe of Texas Commission on Environmental Quality discussed the issue of monitoring reservoirs for algae. Rick Sakaji of the California Department of Health Services pointed out the need to verify the performance of ultraviolet sensors for the UV disinfection of drinking water. Marty Link of the Nebraska Department of Environmental Quality described her coordination of RCRA and other cleanup programs in relation to protecting ground water. Specifically, she is analyzing possible effects of livestock operations on groundwater. John Carlton of the Alabama Department of Environmental Management is currently involved in *enteroccocus* monitoring of bathing beaches as well as determining total maximum daily loads (TMDLs) and nutrient criteria for surface waters flowing into Mobile Bay.

Jeff Schloss of the University of New Hampshire, the president of the North American Lake Monitoring Association, is working with volunteers to monitor the quality of lakes and other surface waters in New Hampshire. Vito Minei, Director of the Suffolk County, New York Department of Health Services said pesticide degradates are big concern in relation to ground water on Long Island. Also of concern are *enteroccocus* and *E. coli* at regional bathing beaches. His group is measuring pharmaceuticals in wastewater from retirement homes. He noted the need for remote sensors that are easy to install and operate reliably over extended periods. Ken Wood of the DuPont Company said that water quality criteria are pushing down effluent limits, for example in Chesapeake Bay with a concomitant need for increasingly precise monitoring for nitrogen and phosphorous among others. He mentioned that Water Environment Research Foundation had funded several projects on removal technologies including on-line monitoring in a treatment plant.

Peter Tennant of the Ohio River Valley Water Sanitation Commission (ORSANCO) described the implementation of a mobile laboratory for monitoring remote locations on the Ohio River. ORSANCO is installing monitors every five miles in the upper 600 miles of the river. Mr. Tennant is examining how ammonia, under cold-water conditions, may be affecting chlorination demands. He is concerned about the effect of nutrients in the Ohio River system on hypoxia in the Gulf of Mexico. He noted the challenge of on-line nutrient monitoring. Mr. Tennant reported that the next Water Quality Monitoring Conference will be held in May 2004 in Chattanooga, Tennessee.

Geoff Scott, Director of NOAA's National Ocean Sciences Laboratory in Charleston, South Carolina, said his lab is particularly concerned about biotoxins. He said that the lab has succeeded in identifying 83% of the molecular structure of *phisteria.* Dr. Scott is involved in researching *vibrios,* microbial source tracking, and the induction of antibiotic resistance. He reported antibiotic resistant *e. coli* resulting from pharmaceuticals in surface water run off golf courses near resort and retirement communities in South Carolina. He is interested in continuing to develop, in conjunction with the National Institute of Standards and Technology (NIST), standard reference materials for pharmaceuticals. He is also participating in a mesocosm study of the pesticide fipronil, which kills shrimp at sub-parts per trillion levels and has a half-life of 600 days. Dr. Scott said that he hopes U.S. EPA will examine the issue of and fund research in microbial source tracking.

VERIFICATION STATUS: ATRAZINE TEST KITS
Amy Dindal, Battelle
Alan Cherepon, Texas Commission on Environmental Quality

Amy Dindal, Battelle AMS Center Verification Testing Leader, described verifying the performance of test kits for detecting atrazine in water. At its laboratory in Duxbury, Massachusetts Battelle tested four immunoassay-based technologies, three of which were quantitative technologies and one a qualitative technology. Ms. Dindal described the design of the test in which environmental water samples were spiked with from 0 .1 ppb to 5 ppb of atrazine. Water samples included fresh surface water, brackish surface water, groundwater and chlorinated drinking water. Three replicates of each sample were analyzed. Testing included quality control, method detection limit and cross-reactivity samples. Sample splits were sent to U.S. EPA's Environmental Chemistry Lab at Stennis Space Center for reference laboratory analysis. The performance of the four technologies was verified in terms of accuracy, precision, linearity, method detection limit, rate of false positives/negatives, matrix interference and cross-reactivity.

The ETV team verified the following technologies:

Abraxis LLC: Atrazine ELISA Kit
Beacon Analytical Systems, Inc.: Atrazine Tube Kit
Strategic Diagnostics, Inc.: RaPID Assay Kit
Silver Lake Research Corporation: Watersafe Pesticide Test.

Identifying the subject technologies as A, B, C, and D, Ms. Dindal presented preliminary test results in terms of each of the test parameters. The tests yielded the following general results:

- MDLs for the three quantitative technologies ranged from 0.06 to 0.10 ppb.
- Previous experience in performing immunossays is important when using quantitative kits
- All quantitative kits detected cross-reactive compounds
- Several technologies showed apparent evidence of interference from the brackish water matrix.

Ms. Dindal reported that ETV Water Committee Stakeholders Ken Wood and Marty Link reviewed the test/QA plan and were slated to review the verification reports. She said the final reports will be available in the spring of 2004.

Alan Cherepon of the Texas Commission on Environmental Quality partnered with Battelle in the verification test of atrazine test kits. Mr. Cherepon served as the operator of the test kits. Atrazine is widely used as a pesticide in Texas. Mr. Cherepon said that immunoassays are economical, reliable, rapid, field portable and have lower detection limits than standard lab methods. He summarized the use and evaluation of immunoassay technology in Texas in relation to the state's pesticide management plan, published in 2001. The state's plan coordinates with U.S. EPA's program for the prevention of pesticide contamination of groundwater. Initially the plan addressed four pesticides: atrazine, metolachlor, alachlor and simazine.

Mr. Cherepon described ground water monitoring in Texas including special surveys conducted in conjunction with the Texas Department of Agriculture and the U.S. Geological Survey (USGS), which is measuring contaminants in the parts-per-trillion range. An interagency database collates information on pesticides. Special pesticide surveys are being conducted to monitor public water systems. Cooperative monitoring is underway to screen every aquifer in the state. Monitoring is also focusing on areas of high atrazine use in the Texas Panhandle. Objectives of interagency cooperative monitoring include analyzing water from 3,000 wells for atrazine and metolachlor and monitoring every Texas aquifer within five years. Using a Texas state map, Mr. Cherepon illustrated the results of cooperative groundwater screening, 2000 to 2003, for atrazine and metochlor.

Mr. Cherepon said that immunoassay testing provided economical and rapid screening for pesticides in groundwater. He said immunoassays are fast, effective and reliable. They delineate "real time" sources and plumes and are most useful for large well fields. They indicate the relative age of the contaminant. Their use saved Texas more than $1 million over five years. Using cut-off concentrations reduces the number of samples sent to the laboratory. Limitations of immunoassays include:

- Cross reactivity with triazines and metabolites
- Results require lab confirmation
- Immunoassays' use is limited by staff's abilities
- Data requires qualifiers and can be misinterpreted
- The method has +/- 20% precision
- Concentrations of greater than 5 ppb require dilution.

Mr. Cherepon recommended keeping track of developments in immunoassay technology, as simpler methods are soon to be commercially available. He also recommended further research on immunoassays in comparison to laboratory analysis for "parent" atrazine, metabolites and structurally related pesticides to address the issue of false positives. He suggested using the results of "real-time" analysis to direct the location of field sampling. It's important, he said, to coordinate immunoassay screening with other agencies and organizations to share expenses and benefits. It's also important to compare commercially available instruments and kits to find those most suitable to meet existing needs.

Geoff Scott noted, "Atrazine mirrors how water leaves the land."

Bacterial Source Tracking in Texas Coastal Waters
Joanna Mott, Ph.D., Texas A & M University Corpus Christi

Joanna Mott discussed technologies and methods for monitoring fecal *streptococcus, enterococcus and e.coli* in Corpus Christi Bay and nearby Gulf of Mexico waters. Dr. Mott said that the purpose of monitoring techniques is to determine sources of fecal contamination in water based on the characteristics of fecal bacteria from different animals. These techniques include

- Phenotypic: antibiotic resistance analysis (ARA) and carbon source utilization
- Genotypic: pulse field gel electrophoresis (PFGE), ribotyping and polymerase chain reaction (PCR).

Dr. Mott said there is no single standard method for bacterial source tracking with each technique offering advantages and drawbacks. Phenotypic methods tend to be cheaper and faster than molecular methods. She said it was important to conduct physical tracking before source tracking. In South Texas waters ARA, carbon source utilization and PFGE are used to track sources of bacterial contamination.

Antibiotic resistance methods, also known as multiple antibiotic resistance (MAR), antibiotic resistance profiling (ARP) and antibiotic resistance analysis (ARA) are used to identify *E. coli* and fecal streptococcus, including the enterococci. Bacteria from the gastro-intestinal tracts of a range of animals should exhibit different profiles of resistance to antibiotics due to environmental influences and degree of exposure to antibiotics. For example, human fecal bacteria are expected to have greater resistance than wildlife fecal bacteria, given the question of how much exposure to antibiotics wildlife have had. (Another consideration with wildlife is seasonal sampling with the huge number of migratory birds moving through the South Texas – Gulf region.) The fecal bacteria of domestic animals may have resistance depending on the medicines and food additive given these animals. In this approach, bacteria are exposed to a panel of antibiotics. Growth and zone of inhibition are used to evaluate bacterial response to the antibiotics. Statistical analysis enables discriminating among isolates of different origin.

PFGE, made commercially available by BioRad Laboratories, identifies the DNA "fingerprint" of *E. coli* strains. Data are analyzed using digital imaging and diversity database software. Restriction enzymes cut DNA at specific locations. Resulting segments are run through electrophoresis to generate banding patterns, which Dr. Mott illustrated, to be compared with patterns of known strains. She said PFGE has an accuracy rate of 70% or better, but that sample turnaround is relatively slow. This method can be costly, requires staff with specific laboratory training as well as a database of regional strains. The ability to represent accurately which *E. coli* strains are in a given watershed depends on the number of strains identified relative to the total number of *E. coli* in the sample and the number of samples taken.

Dr. Mott also described vision image analysis, which uses a plate reader with a color digital camera to provide instantaneous plate reading and interpretation and digitized data color images saved permanently in electronic format. She said this inexpensive, simple procedure provides high "throughput" with relatively little equipment. It's an approach based on probability and provides additional information on antibiotic resistance. Its best discrimination is between human and non-human and requires a database/library of known sources.

She also discussed carbon source utilization, specifically the Biolog Microbial Identification System. This system uses 96-well microplates containing different carbon sources to identify enterococci and confirm the presence of *E. coli.* In this system, change in color denotes use of a carbon source. Discriminant analysis is used to distinguish sources. Dr. Mott noted that there were very few commercial technologies available for source tracking. Her fieldwork compared the IDEXX Enterolert with U.S. EPA Method 1600 for *enteroccus* monitoring. John Carlton noted that his group does not use Enterolert because of its uncertainty. The Enterolert device can provide results in 24 hours.

Dr. Mott said that specific watershed characteristics, inputs from sanitary sewers, seasonal changes and rainfall must be taken into account with any of these procedures. With ARA, she said it's important to survey for potential animal sources of bacteria and to know the history of antibiotic treatment and the use of feed additives. With a library of known sources, "larger is better" and representativeness is important. Dr. Mott noted that still to be resolved are issues concerning the size of the required database; geographical variability; the number of unknown isolates needed; and bacteria transport on surfaces, sediment, regrowth and survival (for example, *E. coli* in tropical soils and sediments).

Dr. Mott described ARA and carbon source utilization (CSU) studies she conducted and PFGE studies conducted by colleague, Roy Lehman. Her research in the Oso Bay/Oso Creek area of Corpus Christi Bay found that the principal bacterial sources were human, laughing gulls, brown pelicans, cows and dogs. Results after rainfall did not indicate a significant increase in human source bacteria. Overall, 82% of isolates were from non-human sources. Oso Bay/Creek data showed few isolates with resistance to more than one antibiotic.

Dr. Mott applied the carbon source utilization procedure to coastal/beach waters focusing on *Enterococcus* spp. Four hundred plus isolates from likely sources (human, cow, dog, bird) were analyzed with good initial results: greater than 90% discrimination of human vs. non-human bacterial sources; greater than 80% for human vs. cow vs. bird vs. dog.

Dr. Mott said that screening techniques can be usefully combined: ARA can run numerous isolates cheaply and develop good probabilities of sources, with a follow-up confirmation of subsets using PFGE. She provided examples of bacterial source tracking projects in Texas waters including Capano Bay, Houston, Lake Waco and Lake Benton. She concluded her presentation by discussing the antibiotics targeted in her field studies. She said she would like to participate in cooperative beach monitoring with the ETV program.

Coastal Alabama Beach Monitoring
John Carlton, Alabama Department of Environmental Management (ADEM)

The Alabama Department of Environmental Management monitors the quality of beach waters along the state’s Gulf coast. Fecal contamination is a focus of monitoring. The monitoring program’s overarching goals is protecting the public from bacterial, viral and protozoan infections. Alabama has approximately 50 miles of Gulf beaches and almost 70 miles of bay beaches. Mr. Carlton said that in 1999 ADEM in cooperation with the Alabama Department of Public Health (ADPH) began regularly monitoring bacterial levels at five high-use swimming beaches on the Gulf coast. This monitoring was expanded in 2000 to include six additional sites along the Gulf Coast and around Mobile Bay. The purpose of the program is to provide water quality information to enable the public to make informed decisions about their recreational use of the state’s coastal waters. ADEM and ADPH subsequently established a program website that provides advisory status and bacteriological test results for each of the monitoring sites.

Mr. Carlton discussed the consequences of the federal B.E.A.C.H. Act of 2000, an amendment to the Clean Water Act. The Act authorizes a national grant program to assist state, tribal and local governments in monitoring for pathogens and pathogen indicators and notifying the public about coastal recreational waters. The Act requires states to adopt improved water quality standards for pathogens and pathogen indicators for their coastal recreational waters by April 2004. In response ADEM developed plans for risk-based beach evaluation and classification, tiered monitoring, public notification and risk communication and public input and evaluation.

Mr. Carlton said the state’s first step was to identify all beaches and similar points of public access. Next beaches were classified in terms of use, risk and other factors. Risk was evaluated in terms of past water quality advisories or unacceptable samples and sanitary conditions related to septic tanks; sewer treatment plants, lines or outfalls; stormwater discharges; marinas/boats; feed lots; concentrations of birds or other animals; water movement and weather. Other factors were taken into account such as a high degree of use by the elderly or very young. Ranking/classification was based on the following formula: Use (60%) + Risk (30%) + Other Factors (10%).

ADEM then developed a plan for tiered monitoring ranging in frequency from twice per week (Tier 1) to as needed (Tier 4). Mr. Carlton said that special sampling may occur in response to rainfall, sewage spills or illegal dumping that could affect swimming sites, and medical reports of swimming related illness. He noted that under some circumstances the local health department could issue an advisory without sampling data.

In 2003 Alabama expanded the purview of its coastal water monitoring to 24 recreational beaches. ADEM is focusing monitoring on Enterococcus and fecal coliform bacteria, which indicate fecal pollution in water. Mr. Carlton noted EPA's single sample maximum standard for marine swimming waters: not more than 104 colonies per 100 ml of water. He said the ADPH laboratory performs *enterococci* analysis using EPA Standard Method 1600. This method provides a direct count of bacteria in water based on the development of colonies on the surface of a membrane filter. ADPH and EPA whole body water contact standard for *enterococci* is 104 colonies/100 ml (single sample maximum). All fecal coliform analysis is performed by the ADEM mobile branch laboratory using EPA Standard Method 9222D (membrane filtration method). ADEM's coastal whole body water contact standard for fecal coliform is 100 colonies per 100 ml. ADEM intends to propose a new standard based on *enterococci* by April 2004.

Mr. Carlton noted that 80% of beach advisories appear to be related to the runoff of rainfall within the previous 24 hours. He said the public is informed of beach water quality through a variety of means including EPA and ADEM websites, beach signs, press releases and information in the *Mobile Press Register*. He illustrated types of signs indicating status of swimming water quality. Mr. Carlton reported that since the program's inception more than 2,500 samples have been collected and analyzed. In fiscal year 2003 more than 800 samples were collected and analyzed and 28 beach advisories were issued by ADPH. Mr. Carlton concluded his presentation by describing the monitoring program's public review forums and partners.

Geoff Scott commented on the value of presenting Doppler information on rainfall associated with beach closures to inform the public about alternatives to swimming. Vito Minei noted that the enormous economic value of Long Island's bathing beaches: in the range of $350 million.

Next Technology Categories to Consider for Verification
Karen Riggs and Todd Peterson, Battelle

Ms. Riggs reviewed progress since the committee's last meting. In addition to the verification tests discussed in this meeting, the AMS Center is proceeding with a verification test of arsenic monitoring technologies. This round of test would be the third for this technology category. Ms. Riggs reviewed vendor/partner recruitment for nutrient monitors. Battelle has identified a number of vendors and possible partners for two potential areas of application: on-line nutrient sensors and in-situ nutrient analyzers for ocean, coastal and surface waters. Ken Wood noted that on-line nutrient sensors are important for process monitoring rather than compliance. Geoff Scott offered NOAA sites near Charleston, South Carolina for verification testing of in-situ nutrient analyzers. Christine Kolbe is using the commercial technologies AquaCon and GreenSpan for in-situ nutrient analysis.

Todd Peterson asked stakeholders to review the priority for verification of past recommendations and to provide new recommendations. Past recommendations *(and stakeholder comments)* included:

- Non-membrane dissolved oxygen probes. *(Stakeholders identified GreenSpan, Royce and Insite IG as commercially available technologies. Stakeholders indicated that the same test/QA plan could be used for these* *technologies as for multi-parameter water probes. Rick Sakaji noted that these technologies could be used in industrial applications as well as for ambient monitoring.)*

- Technologies to detect the long-term effects of oil spills. (*No commercial technologies available; let U.S. EPA STAR grant program know that these technologies are needed.)*
- Biomarkers to detect pharmaceuticals and endocrine disruptors. *(Post these needs on the ETV Website. Post development needs in the Monitor. Contact pharmaceutical companies for information. Geoff Scott noted that the Alliance for Coastal Technology (ACT) will have a meeting on emerging contaminants and that vendors should be asked if they making immunoassay test kits for biomarkers/pharmaceuticals. Marty Link said that laboratory methods for pharmaceuticals are still being developed. She offered to identify a contact in the pharmaceutical industry.)*
- Remote sensors. (*Not commercially available, NASA tends to commercialize; aerial photography; digital mapping; satellite monitoring – Universities of Wisconsin and Minnesota.)*
- Flourimeters. (*In-situ/submersible, would like a broader range than chlorophyll-chlorophyll a, i.e.: total chlorophyll, phytoplankton blue green algae, etc. multi-wave length flourimeter. There are two or three companies selling scanning flourimeters, need to note all units are measuring relative fluorescence not chlorophyll, need to compare to extracted results to report chlorophyll a with confidence. Jeff Schloss can provide names of manufacturers/researchers.*
- On-line perchlorate analyzers. (*Rick Sakaji said he knows of only one vendor: Dionex.)*
- Passive samplers for organics in water. *(Originally Roy Spalding's suggestion, Mart Link indicated these samplers are not especially useful.)*
- Semi-permeable membrane devices either filled with triolein to monitor persistent bioaccumulative toxins in surface water and combined sewer overflows or with solvent to monitor volatile organic compounds. *(Geoff Scott identified one commercial technology vendor: Columbia Lab; Mick DeGraeve – no vendors; PISCES technology is filled with hexane, made primarily for government agencies for TOPS.)*
- Polycyclic aromatic hydrocarbon screening methods. *(Kit from SDI/Abraxis, UV for sediments. John Carlton noted the importance of verifying if these technologies are being used. He noted that there may be a couple of vendors.*
- Groundwater velocity monitors
- Downhole, real-time sensors. *(Measuring TCE, volatiles, petroleum products, explosives, RDX; Geoprobe technology. Marty Link will check with someone in Kansas who does a lot of work with Geoprobe to assess the state of this technology.)*
- Multiparameter probes round 3. *(Stakeholders suggested conducting this test with non-membrane DO probes.)*

Mr. Peterson asked stakeholder to consider the following questions in making their recommendation:

Is the technology category well defined?
Is this technology category important to verify? Are performance data needed?
Are there vendors with commercially-ready technologies available?
Who are potential partners that could co-fund a verification test?
Which stakeholders have interest or experience with this technology category and would be willing to support the verification test?

Stakeholders recommended the following technologies be considered for performance verification:

- On-line nutrient monitors
- Multi-parameter water probes round 3/non-membrane dissolved oxygen sensors
- Pesticide (alalchlor, metachlor) immunoassays
- Microcystin ELISA test kits

Stakeholders recommended that EPA/Battelle maintain communication with vendors of beach monitoring technologies and to check on vendors with in-situ flourometers and polyaromatic hydrocarbon immunoassay kits. Stakeholders also recommended assessing vendor/user need for remote sensors, on-line perchlorate monitors and down-hole sensors.

Water Quality Monitoring Needs and Issues: Toxic Algal Blooms
Greg Southard, Texas Parks and Wildlife Department

Greg Southard of the Texas Parks and Wildlife Department (TPWD) Fish Health and Genetics Laboratory illustrated the devastating effects of harmful algal blooms on fish in Texas inland waters. He identified species of toxic microalgae, and the mechanisms by which these microorganisms harm fish. Mr. Southard focused on *Prymnesium parvum*, also known as golden algae, which is responsible for many catastrophic fish kills in Texas. TPWD is very concerned with monitoring technology for the early detection of *Prymnesium parvum.*

Mr. Southard reported that *P. parvum* was first identified in Holland and Denmark in the 1930s. Fish kills attributable to this toxic alga have been reported in 12 countries around the world. In the United States golden algae is responsible for killing fish in Texas, New Mexico, Wyoming, North and South Carolina, Arkansas and Alabama. Mr. Southard reported that is *P. parvum* is widespread in Texas, affecting the Canadian, Red, Brazos, Colorado, Rio Grande (Pecos) and Sulphur river basins. Fifteen reservoirs have also been severely affected. In addition, *P. parvum* has degraded the water quality of state fish hatcheries, which produce a variety fish species including striped bass and rainbow trout. For example, in April 2001, the toxic algae killed all the striped bass fry and hybrid striped bass fry in the Dundee State Fish Hatchery.

Since 1981, *P. parvum* has killed an estimated 17.5 million fish worth more than $ 7 million. In response TPWD has convened a golden algae task force. Among other tasks, the task force is carrying out a statewide survey concerning golden algae and conducting a partial genomic study of *P. parvum.* The task force participated in a golden algae workshop in Ft. Worth, Texas in October 2003 with international experts on *P. parvum* and harmful algal blooms. The workshop resulted in a plan of action and identification of research needs. A need of particular interest to the AMS Center water monitoring stakeholder committee was the development of hand-held field technologies to rapidly identify alga and toxins.

The TPWD inland fisheries *P. parvum* task force is researching how toxic algal blooms occur, what causes the production and release of toxins, and what strategies will most effectively control golden algae. Mr. Southard provided images, magnified 400 to 1000 times, of *P. parvum* as well as a light micrograph of an algae's cell and an electron micrograph of its scales. Mr. Southard said that TPWD is using a hemacytometer to measure *P. parvum* cell densities (number of cells/mL). Densities are also being measured with Palmer-Maloney, PhycoTech^{R} nanoplankton and Sedgewick-Rafter counting chambers and settling chambers (Utermohl, etc.)

Mr. Southard identified the specific toxins types and toxic effects associated with *P. parvum.* He illustrated the molecular structure of *P. parvum* toxins prymnesin-1 and –2 and hemolysin, and discussed the relationship between toxicity and environmental factors. He also described bioassays using juvenile fathead minnows to monitor toxin levels. He compared bioassay toxicity testing with the cell counting approach, reporting that both methods are time consuming, labor intensive and not always reliable as a measure of an impending bloom or a toxic event. He said simpler, quicker and more accurate methods are needed to identify *P. parvum*, to estimate its cell density and to detect and monitor its toxicity. He specified molecular-based techniques including ELISA, microarray readers, biosensors/probes and polymerase change reaction (PCR).

ETV Advanced Monitoring Systems Center Expansion into Soil Monitoring

Amy Dindal provided historical perspective on ETV soil monitoring. The ETV Site Characterization and Monitoring Technologies (SCMT) Pilot conducted verification testing in soil monitoring. Technology categories tested included x-ray fluorescent instruments, gas chromatographs/mass spectrometers, infrared monitors, immunoassay kits, fiber optic chemical sensors, ion mobility spectrometers and ion specific electrodes. Implementation of the six-center approach after the ETV Program's five-year pilot phase incorporated SCMT activities into the AMS Center. Ms. Dindal noted that to date the AMS Center had verified no soil/sediment monitoring technologies. Ms. Dindal also noted that soil and water monitoring technologies are largely complimentary and suggested that the focus of this committee be expanded to include consideration of soil monitoring technologies. Stakeholders agreed to begin consideration of soil monitoring technologies at its next meeting in the fall of 2004, and recommended the addition to the committee of experts in soil monitoring. Contacts to be made for new committee members include Herb Brass of U.S. EPA and Lisa Olsen of the U.S. Geological Survey. The committee also recommended the addition to the fall meeting of a half-day session so that a full day could still be committed to water monitoring.

Verification Status: Multiparameter Water Probes Round 2
Karen Riggs, Battelle

Karen Riggs, Battelle's AMS Center Program Manager, reported that NOAA worked closely with Battelle in conducting a second round of testing of multiparameter water probes. NOAA made available facilities and staff at the Center for Coastal Environmental Health and Biomolecular Research (CCEHBR) near Charleston, South Carolina. The Battelle/NOAA team conducted testing during the fall of 2003. Reports of test results are now being prepared. Stakeholders Vito Minei, Robert Waters, Christine Kolbe and John Carlton supported the verification testing.

Ms. Riggs reported that two technologies were tested: Aanderaa Instruments RCM MK II and YSI Incorporated 6600 Extended Deployment System. These technologies were deployed in saltwater, fresh water, and in a mesocosm at NOAA facilities. Two probes from each vendor were deployed at the three sites for 29 days in saltwater, 29 days in fresh water, and 25 days in a mesocosm tank at CCEHBR. The research team collected data at 10 and 15-minute intervals from the probes. Reference data were collected at the beginning, middle and end of the testing periods (15-minute intervals for six to eight hours).

The probes measured the following parameters:
- Dissolved oxygen
- Temperature
- Turbidity
- pH (one technology)
- Conductivity (one technology)
- Chlorophyll (one technology).

Ms. Riggs specified the reference methods applied to each of the parameters. In terms of preliminary results, she said many of the results are presented graphically in the report given the large quantity of data. Performance was evaluated independently for each of the deployment sites. Verification parameters included:
- Pre- and post-calibration results
- Relative bias
- Precision

- Linearity
- Inter-unit reproducibility
- Visual record of fouling

Probes were set up with minimal difficulty, and all parts of the testing are now complete. Because the freshwater was highly stratified and brackish, the mesocosm test was extended. Units cost between $10,000 and $15,000. Ms. Riggs illustrated inter-unit reproducibility for saltwater temperature, saltwater dissolved oxygen, and saltwater turbidity for technologies A and B. She showed pictures of technologies A and B in terms of fouling before and after testing in saltwater and fresh water. She noted that technology A was totally untouched between deployments except for a 10-minute cleaning with white vinegar. Technology B used a wiper to periodically clean its multiprobe heads while deployed. Ms. Riggs concluded her presentation by reporting that YSI, Hach and Hydrolab are interested in future verification testing.

ETV Program Update
Teresa Harten, U.S. EPA

Teresa Harten, director of the ETV Program, reported on the status of the program. ETV's achievements to date include the completion of 252 verifications and 78 protocols. Ms. Harten noted that the interests of vendors in participating continues – more than 100 technologies are in testing/evaluation and more than 100 applications are pending. The ETV Program continues to get tremendous external support, with 805 stakeholders in 21 groups providing technical guidance. The program received more than $1 million in vendor contributions in 2003, bringing the total of vendor cash contributions over the life of the program to almost $4 million. The ETV Web site continues to gain popularity with more than 80,000 "hits" in December 2003 alone. Ms. Harten said that projections for the program in 2004 include completion of more than 80 verifications, half in base ETV and half in homeland security technologies. One focus of Ms. Harten's office is to determine the ETV Program's direct outcomes. The Association of State Drinking Water Administrators' 2002 survey provides examples of how the ETV Program is strengthening environmental protection. The survey's results indicated that:

- 26 states use ETV protocols and test plans to verifying the performance of drinking water treatment equipment
- 12 states reference ETV protocols as methods for site-specific testing
- 20 states use ETV verification reports to reduce the frequency and length of pilot tests
- 12 states use ETV verification reports as prerequisites to permitting of a technology
- 16 states use ETV verification reports as primary sources of information for decision-making.

Next Meeting

Stakeholders selected the Denver/Colorado Springs area for the committee's next meeting in September or October 2004.